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A PRIMER
ON COMMUNITY NOISE

city planning noise abatement

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DEPARTMENT OF ENVIRONMENTAL QUALITY
CITY OF LOS ANGELES

INTRODUCTION

This primer was prepared to assist City officials in a better understanding of the nature of sound and noise. An understanding of sound is required for the proper abatement of noise. Land use management techniques for noise abatement include site design analysis, environmental zoning, building codes, and noise regulations.

Whereas noise in the City is seldom a primary health hazard, of all environmental pollutants it is among the most annoying, the least regulated, but the easiest to abate. Also, habitation quietude is guaranteed by the 5th, 9th and 14th Amendments of Constitution.

The chief sources of noise annoyance in the City of Los Angeles are air conditioning compressors, fans and blowers, pumping and filtering equipment, construction equipment, delivery trucks, catering trucks with amplified sound, and radio and hi-fi equipment as well as industry and transportation.



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COMMUNITY NOISE

Figure 1 represents an idea of sound levels, in decibels, for various familiar sound sources and distances. The fact that a decibel is the logarithmic ratio of a measured sound pressure level to a standard reference sound pressure level should be of little concern to the lay person, but it is important to understand at least what is meant by the "logarithmic" nature of sound levels. To put it simply, Figure 2 shows that each increase of 10 dBA doubles the "loudness" of a sound, and each 10 dBA decrease halves the "loudness". The "A" in dBA merely means that the sound pressure level was measured with a sound level meter which "hears" the way the human ear does, i.e., it is biased against the lower frequencies (pitch). Human beings do not hear low audio frequencies very well, and an "A"-weighted meter discriminates in the same manner. This is very important when public reaction to noise is considered.

Figure 3 shows truck noise, in decibels, for various distances from a flat section of freeway at grade without a solid noise barrier of any kind. (R/W means right-of-way).

Figure 4 compares truck noise, in decibels, for various highway designs such as flat section at grade (A_1), 20-foot elevated highway section (B_1 and C_1), 20-foot depressed highway section (D_1), and flat section with an added solid noise barrier (A_2). B_2 and C_2 represent the shielding (solid barrier) of an elevated highway and D_2 represents the shielding of a depressed highway.

Figure 5 shows the reduction, in dB's, for pure tones of different frequencies provided by solid noise barriers. It is readily apparent that high-pitched noises are greatly reduced by solid noise barriers, and high barriers are better than low ones. The most annoying noises are those with high frequencies. High frequencies are also attenuated more by distance than are low frequencies.

Table 1 gives examples of maximum background (ambient) sound levels for various work areas which are compatible with good speech communication.

Table 2 and Figure 6 both show the Federal Occupational Safety and Health Administration noise exposure limits (hours duration permitted for various sound levels) for people at work. Community noise problems are generally annoyance problems and not health problems.

Table 3 gives examples of ambient (background) sound levels in dBA's to be expected in various community areas.

Figure 7 indicates the increase over the ambient level, due to an intrusive noise, which is allowed for intermittent noises. For example, if an intrusive noise occurs 3% of the time under consideration, then the intrusive noise level may be 15 dBA greater than the ambient level, but if the intrusive noise occurs 30% of the time then the intrusive noise level may only be 5 dBA greater than the ambient level. Otherwise, complaints are likely from the public.

Figure 8 combines the criteria for hearing conservation with the criteria for acceptable community noise. The final (combined) criteria reflect the fact that at the higher frequencies, more consideration is given to hearing conservation and at lower frequencies more consideration is given to what is acceptable to the community as related to annoyance.

ENVIRONMENTAL IMPACT REPORTS (EIR'S)

While not excluding other pertinent information, the following specific items are representative of the basic kinds of scientific

and factual data which should be included in EIR's for the determination of significant noise impact:

1. Sound pressure levels measured at sensitive locations (e.g., nearby residential dwellings, schools and/or hospitals) adjacent to and/or surrounding the proposed project site.
2. Predictions of sound pressure levels in these same areas after completion and operation of the proposed project. Such predictions can be made by various algorithmic prediction schemes, by similarity theory (e.g., correlation with similar projects), or sometimes even by using quantitative data from the literature.
3. Mitigation measures if the predicted noise levels will exceed the standards in the City Noise Regulation Ordinance. Laws in themselves do not mitigate noise. Mitigation may be accomplished through proper acoustical analysis and design. Environmental impact must be predicted accurately before an optimized configuration can be established. The design must accomplish what the analysis indicates by choosing proper materials, systems and constructions.

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TYPICAL A-WEIGHTED SOUND LEVELS

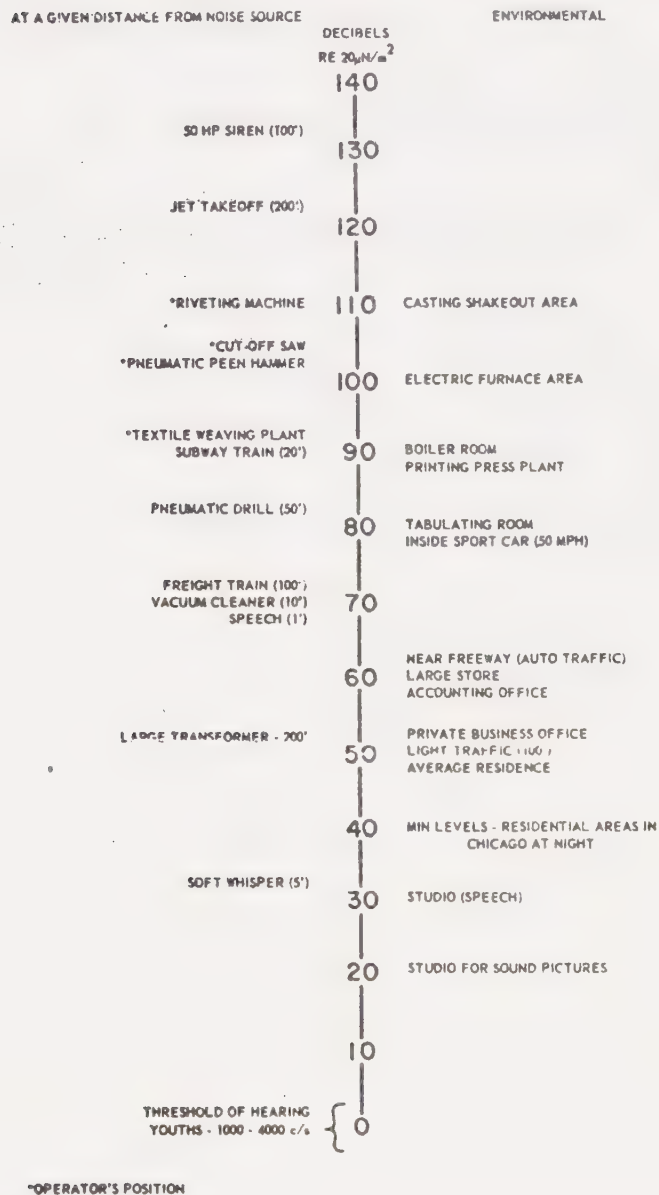


Fig. 1. Typical A-weighted sound levels measured with a sound-level meter. These values are taken from the literature. Sound-level measurements give only part of the information usually necessary to handle noise problems, and are often supplemented by analysis of the noise spectra.

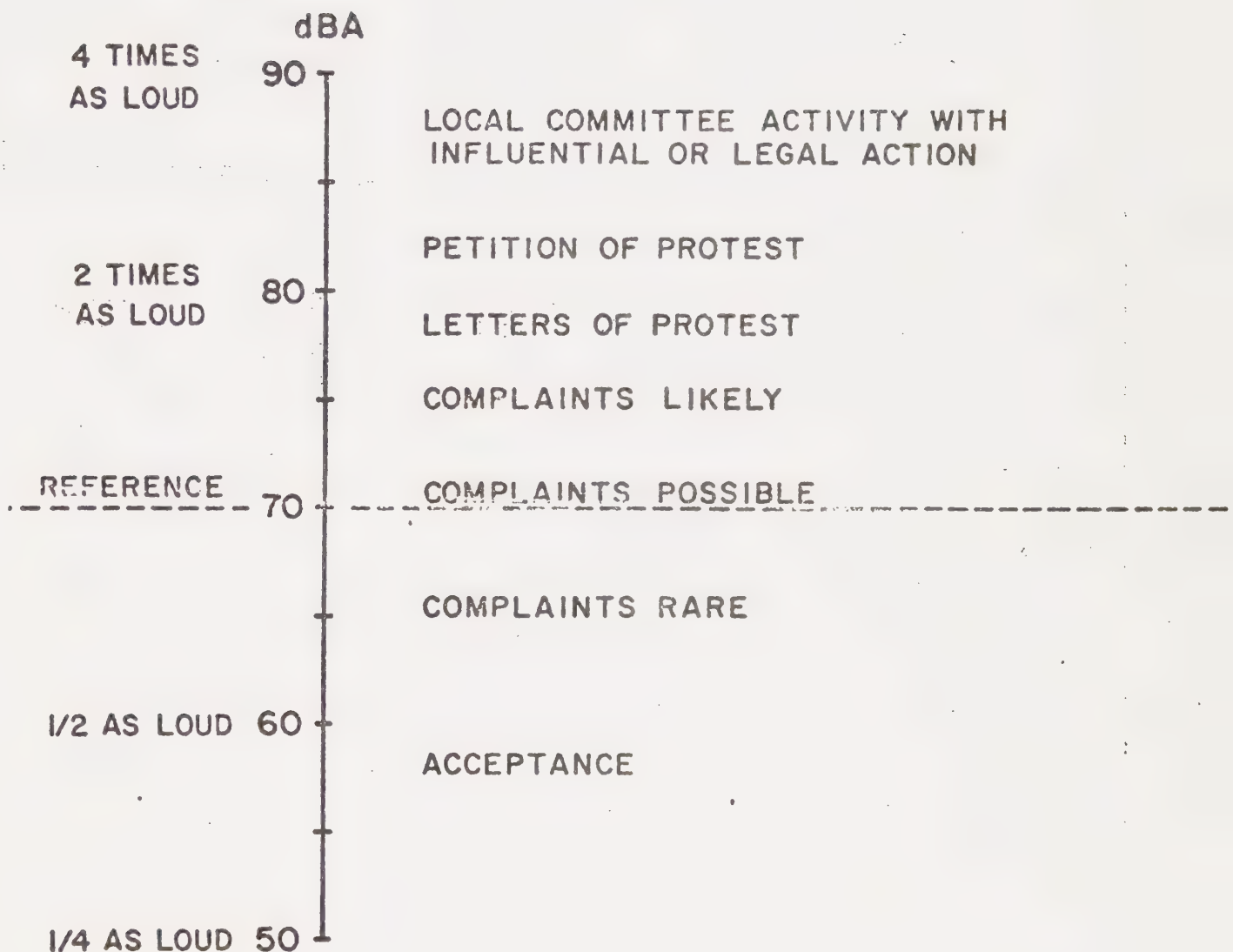


Fig. 2. TREND OF PUBLIC REACTION TO PEAK NOISE NEAR RESIDENCES

FLAT SECTION

DIESEL TRUCK PEAK NOISE RANGE OVER OPEN TERRAIN

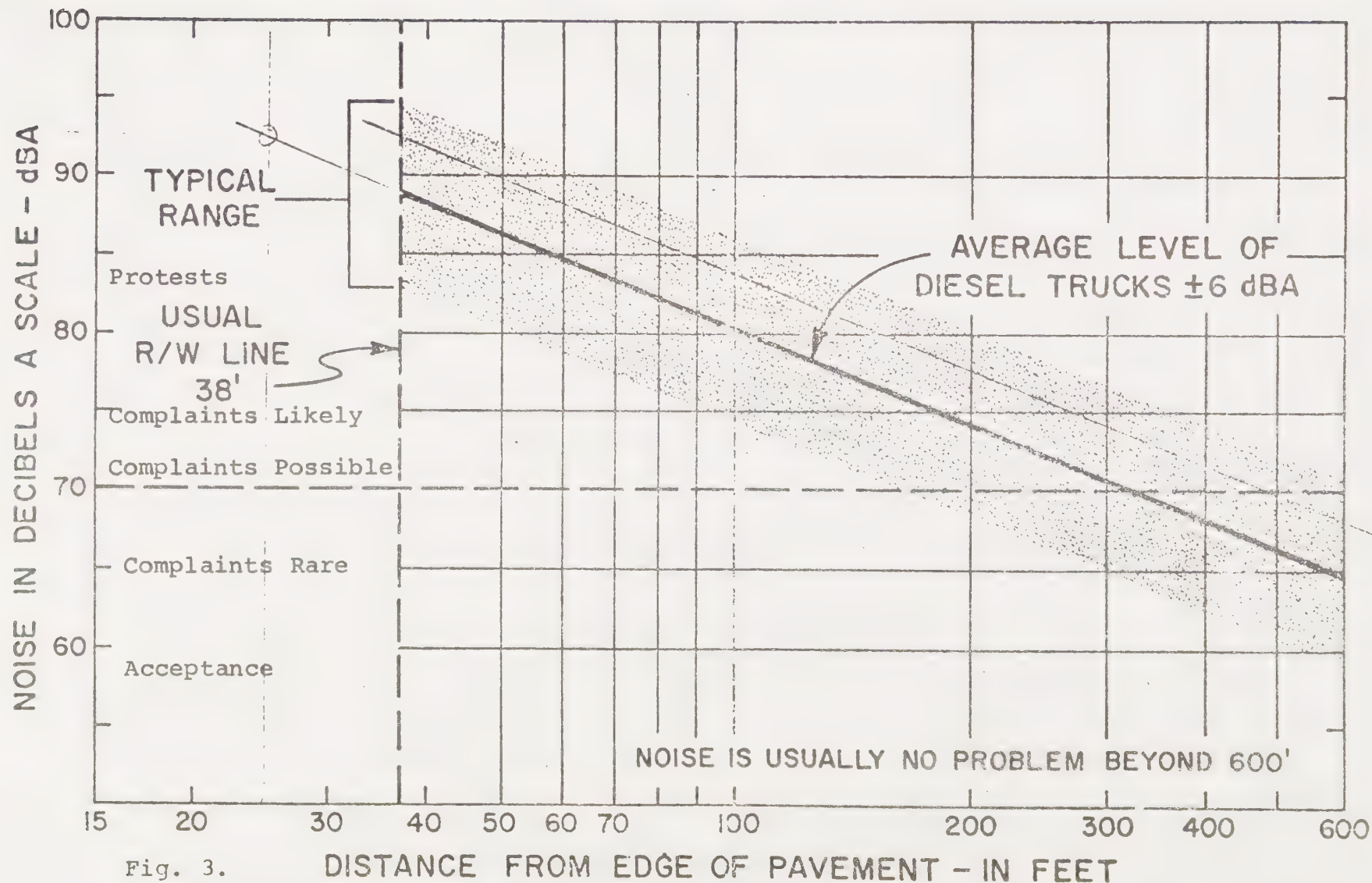


Fig. 3.

DISTANCE FROM EDGE OF PAVEMENT - IN FEET

NOISE COMPARISON CHART FOR DIFFERENT HIGHWAY DESIGNS

BASED ON AVG. TRUCK NOISE WITH ± 6 dBA SPREAD
ADJACENT LAND FLAT AND UNOBSTRUCTED
MICROPHONE 5 FEET ABOVE GROUND

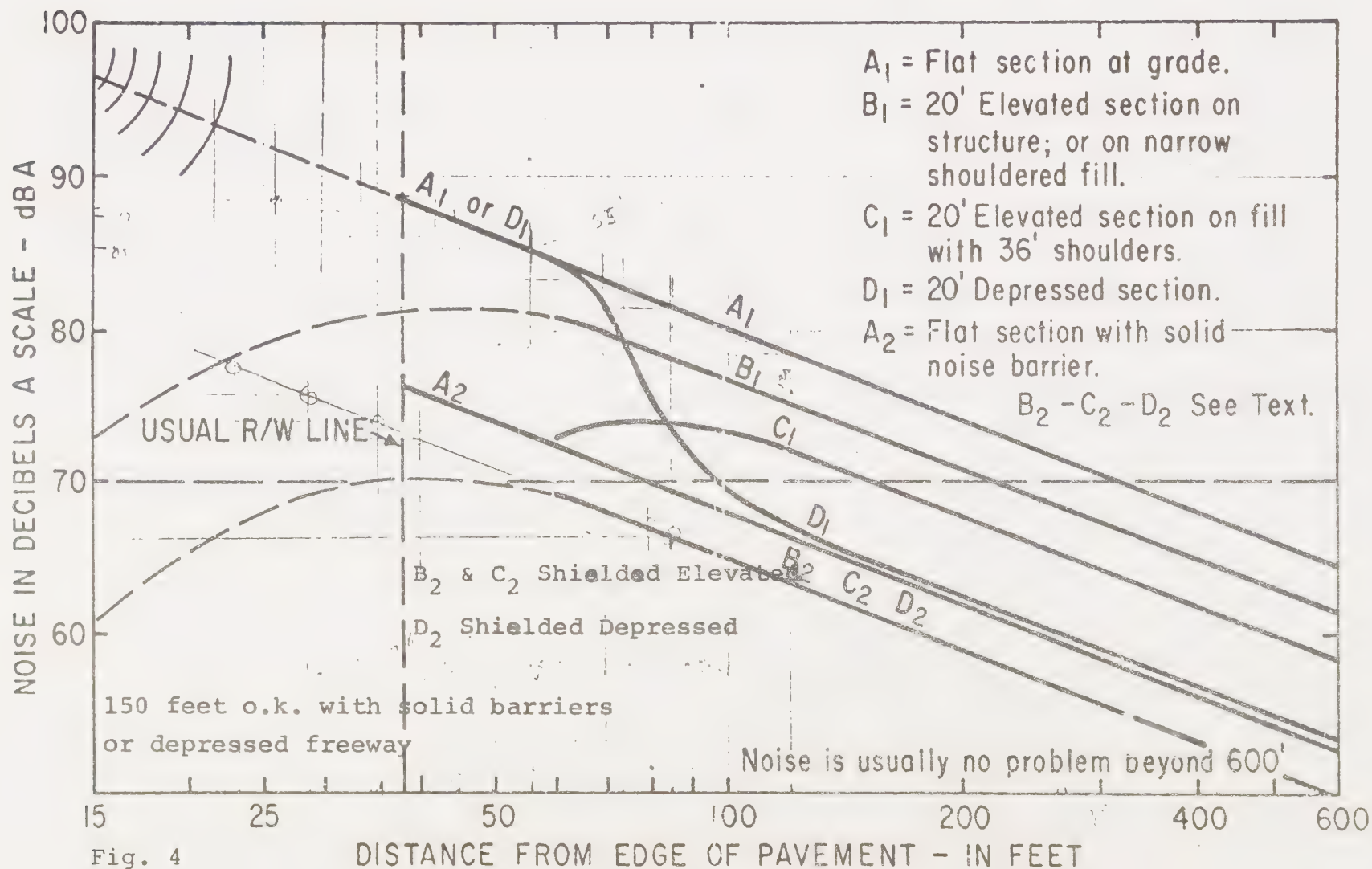


Fig. 4

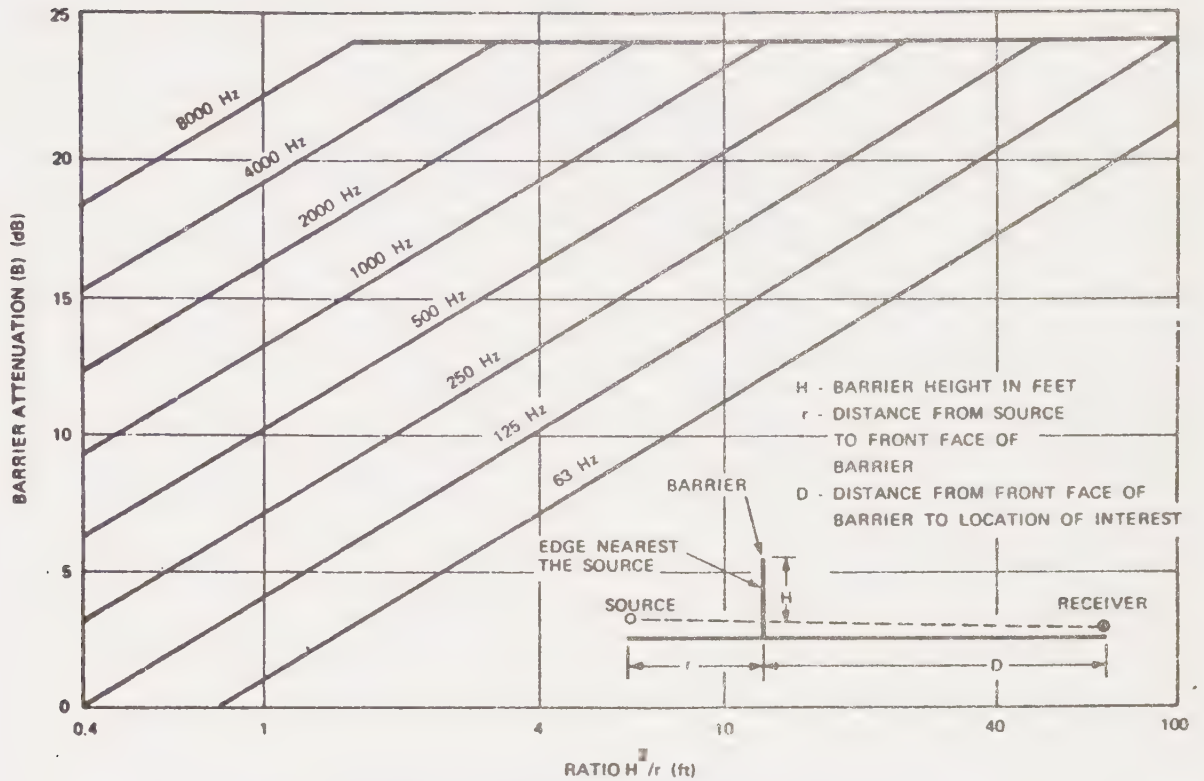


Fig.5 Typical Attenuation Provided By A Solid Barrier for $D > r$ and $r > H$

Example: where $H = 10$ ft., $r = 100$ ft, then $\frac{10^2}{100} = 1$

Example: where $H = 20$ ft., $r = 100$ ft, then $\frac{20^2}{100} = 4$

TABLE 1
Suggested Maximum Levels for
Speech Communication in Various Work Areas

Work Area	A-Weighted Sound Level in Decibels
Large conference room	35
Executive office	35
Conference room for twenty people	45
Private or semiprivate office	45
Conference room for ten people	55
General office areas	55
Control rooms, shop offices, typing areas, etc.	65
Shops, machine rooms, production areas, etc.	75

TABLE 2

OSHA Noise Exposure Limits

Duration Per Day (hours)	Sound Level (dBA)
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

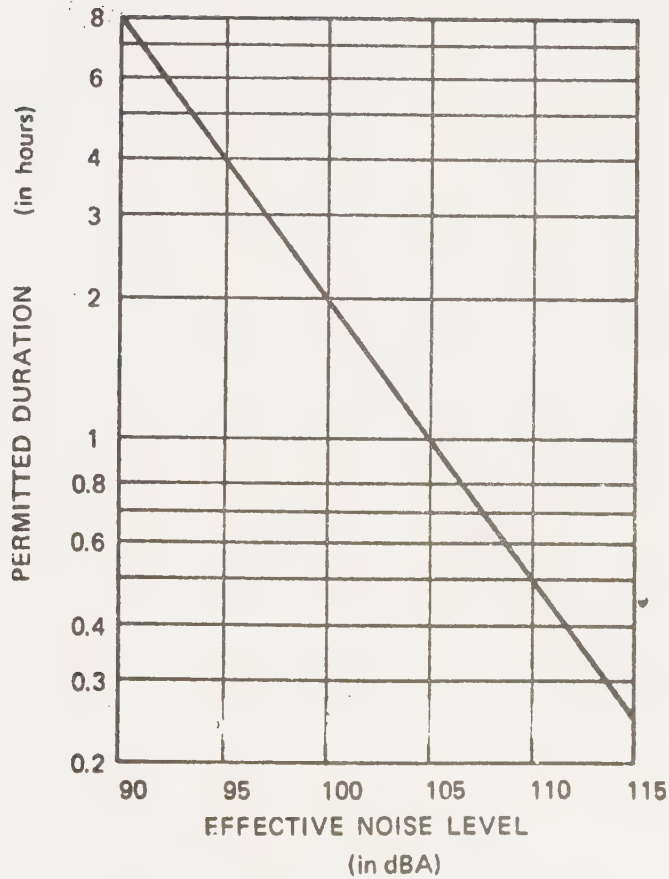


Fig.6 OSHA Noise Exposure Limits

TABLE 3

Guidelines For Community Noise Levels

Area	Sound Level (dBA)		
	Day*	Night	Other
Rural (residential)	50	40	45
Suburban (residential) (also hospital, church, and similar zones)	55	45	50
Urban (residential) (also apartment)	60	50	55
Urban (residential) with some commercial, retail, or light industry	65	55	60
Predominantly industrial	70	60	65
Heavy industrial, few dwellings	75	65	70

*"Day" represents the period 0700-1700 hours on weekdays, and "night", 2200-0700 hours. "Other" includes 1700-2200 hours and, on weekends and holidays, 0700-1700 hours. Where local custom differs, the period should be adjusted to conform. Each time period during which the noise is present should be considered.

Day is 7 a.m. - 6 p.m.
Other is 6 p.m. - 10 p.m.
Night is 10 p.m. - 7 a.m.

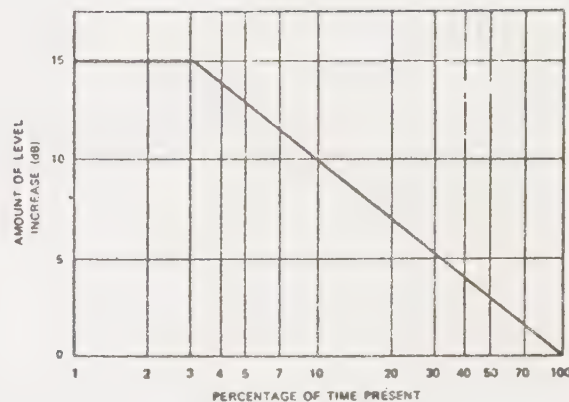


Fig. 7 Community Noise Level Limits for Noise Present Only A Portion of the Time Period Under Consideration.

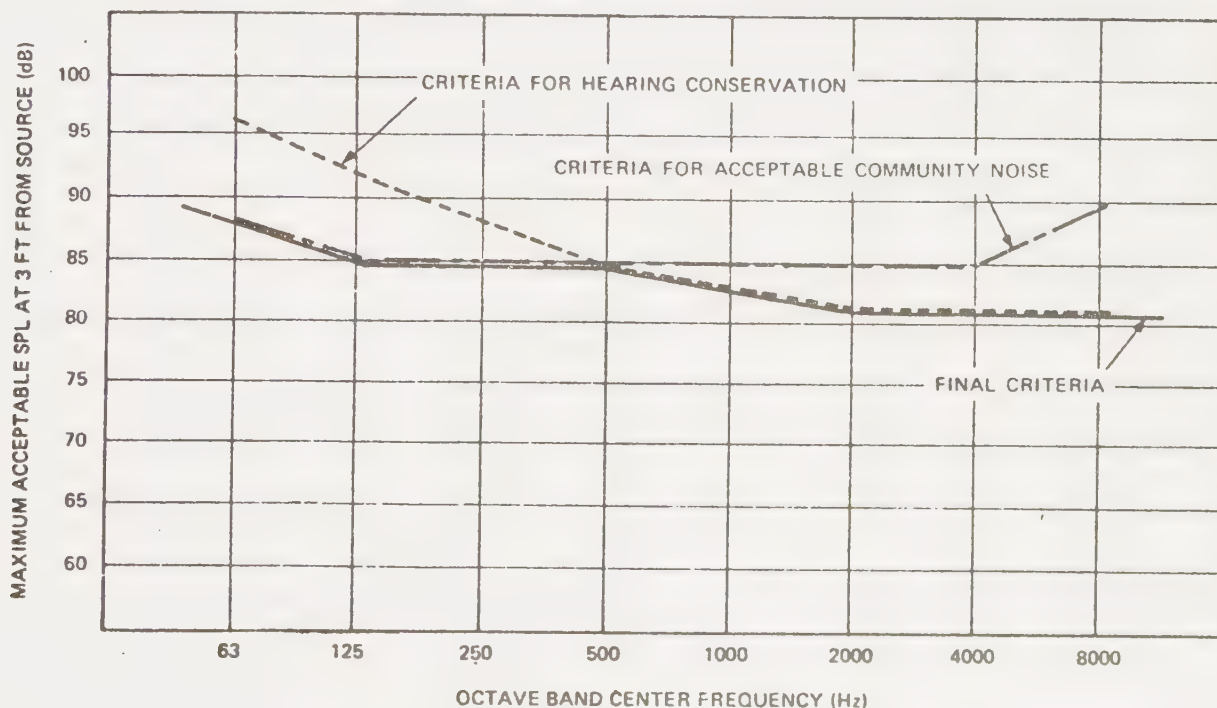


Fig. 8 Combining Community Annoyance and Hearing Conservation Criteria

NOISE
GLOSSARY

ALGORITHM -- a sequence of formulas and/or algebraic/logical steps to calculate or determine a given task.

AMBIENT NOISE -- conglomeration of different airborne sounds from several sources near and/or at a distance, from the point of measurement. No individual sound is considered in the environment.

ATTENUATION, -SOUND -- reducing the intensity of a sound signal.

A-WEIGHTED SOUND LEVEL (dBA) -- A quantity, in decibels, read from a standard sound-level meter that is switched to the weighting network labeled "A". The A-weighting network discriminates against the lower frequencies according to a relationship approximating the auditory sensitivity of the human ear at moderate sound levels.

BACKGROUND NOISE -- Same as ambient noise

DECIBELS -- The unit in which the levels of various acoustical quantities are expressed. Typical quantities so expressed are sound pressure level, noise level, and sound power level.

FREQUENCY -- Time rate of repetition of periodic motion; units are cycles per second or Hertz (Hz).

> -- greater than

< -- less than

INTRUSIVE NOISE -- Unwanted sound from an identifiable (specific) source which can be measured above the background or ambient noise.

LOGARITHMIC -- Exponential rather than proportional or linear.

LOUDNESS -- The intensive quality of sound marked by the effect on the hearing apparatus of varying sound pressures.

MITIGATION MEASURES -- Actions to make an effect less severe.

NOISE -- Unwanted sound, usually annoying or disturbing.

NOISE ABATEMENT -- Reduction of noise.

NOISE BARRIER -- A construction or natural obstruction which blocks transmission or reflection of airborne sound.

NOISE LEVEL -- See sound level.

OPTIMIZE -- To make as effective as possible.

PURE TONES -- Sound sensation that is characterized by singleness of pitch or frequency.

QUANTITATIVE DATA -- Objective, physical, measured information as opposed to subjective awareness or feelings.

SOUND LEVEL (NOISE LEVEL) -- The weighted sound pressure level obtained by use of a sound level meter having a standard frequency-filter for attenuating part of the sound spectrum.

SOUND-LEVEL METER -- An instrument, comprising a microphone, an amplifier, an output meter, and frequency-weighted networks, that is used for the measurement of noise and sound levels in a specified manner.

SOUND PRESSURE -- (1) the minute fluctuations in atmospheric pressure which accompany the passage of a sound wave; the pressure fluctuations on the tympanic membrane are transmitted

to the inner ear and give rise to the sensation of audible sound. (2) for a steady sound, the value of the sound pressure averaged over a period of time.

SOUND PRESSURE LEVEL -- The level of sound pressure; squared and averaged over a period of time.

SPECTRUM -- Of a sound wave, the description of its resolution into components, each of different frequency and (usually) different amplitude and phase.



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to the first and give rise to the appearance of a single
word. (2) For a single word, the value of the word
proceeds straight out a period of time.

Second, the word level -- the level of word processing, appears
and appears over a period of time.

Third, -- at a word level, the description of the word
into components, each of different frequency and (possibly)
different amplitude and phase.